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TECHNOLOGY TRANSFER

IN

MANITOBA AGRICULTURE

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This paper describes the technology transfer process in Manitoba. It was initiated while the senior author was on a four-month secondment at the Manitoba office of the Regional Development Branch.

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INTRODUCTION

The term technology transfer has been applied to a number of very different processes as a brief review of the literature will reveal. It is therefore important to define the term at the outset.

In this report, technology transfer refers to the movement of knowledge among individuals and institutions; that is, the movement of knowledge from researchers, teachers and extension personnel into the hands of those who can apply it. Under this broad definition, emphasis is on the transfer of knowledge about, rather than implementation of, a given technology. Technology, in this instance, refers to a way of doing things and may be rejected by the recipient after the transfer of knowledge for a number of legitimate reasons pertaining to the individual's situation. Moreover, technology transfer is not restricted to those cases where new knowledge is created and moved out of the research area for the first time. The knowledge need not be new but only be new to the recipient.

The technology transfer process has been reviewed for all major industries but most attention has been directed at agriculture. There are a number of reasons for this. Agriculture is a highly competitive industry with respect to international trade, and Canadian producers, faced with certain geographic and climatic

constraints, must maintain a high level efficiency if they are to compete in world markets. Within the industry, rapid technological change is commonplace. Perhaps more than in any other industry, public and private research and development generate a wide range of emerging technologies on a continuing basis designed to increase output, reduce costs, conserve resources and/or improve product quality. Both the industry and its consumers benefit when this knowledge is quickly transferred to the producer. Moreover, studies have shown that there are barriers to technology transfer, that technological gaps do exist and that economic gains can be realized by improving the transfer process.

The traditional nature of the agricultural industry contributes to the importance and complexity of the technology transfer process. Essentially all agricultural research is carried out off the farm which means all new knowledge must be transferred before it can be applied. This task is made all the more difficult because of the large number of producers who are highly dispersed geographically. Adding to the problem is the fact that there is a significant level of entry/exit at the producer level which results in thousands of new farm operators in the industry each year. Thus, there is a continuing need to re-introduce fundamental and emerging technologies at the farm level.

Recognizing the importance of technology transfer to the economic health and growth potential of the industry, a large

number of programs and services, aimed at strengthening the transfer process, have developed over time. Both levels of government, educational institutions and the private sector are involved, thereby creating a large infrastructure representing a substantial commitment of financial and human resources. There would appear to be a general consensus that the technology transfer process works quite well in Canadian agriculture; however, little analysis of a positive, or normative, nature has been carried out in recent years in support of this position. There are also questions about how incremental resources aimed at technology transfer should be allocated. As evidence, the "Technology Transfer in Agriculture" think piece completed in December 1982 for the Regional Development Directorate, Agriculture Canada by Dr. A.M. Fuller points out a number of concerns regarding the current transfer processes and recommends a thorough review of the prevailing system.

These concerns are of increasing importance to Agriculture Canada in light of the agri-food strategy commitments and responsibility for the ERDA agriculture sub-agreements. The Department's contribution to the design of effective technology transfer programs and services would be enhanced through analysis in the following specific areas:

- documenting the existing technology transfer infrastructure,
- identifying emerging technologies,
- measuring technological gaps,

- determining the causes of specific technological gaps,
- identifying alternative technology transfer mechanisms,
- establishing criteria for selection of technology transfer mechanisms,
- developing monitoring and evaluation procedures for transfer programs.

The present report addresses the first of these study areas. The objective is to provide an overview of the formal process by which knowledge is transferred from researchers, teachers and extension personnel to farmers. The term "formal process" refers to the activities of organized bodies such as government, farm organizations, agri-business and educational institutions. That is, what role does each group play, what linkages and communication channels have been developed?

A number of limitations are introduced to reduce the scope of the study. Firstly, only farm level technology is examined. The transfer process in areas such as marketing, processing, etc. is left for future analysis. Secondly, of the development-assessment-adoption stages in the transfer process, only the adoption stage will be documented. The mechanisms by which specific technologies are selected for research and development and the methods by which those technologies are assessed for commercial use are outside the scope of this report.

In addition, it should be noted that documentation of the transfer process in this study is restricted to the province of Manitoba, although the framework developed could be used for

other provinces with minor revisions. Finally, readers should understand that this report provides a description and not an evaluation of the existing technology transfer infrastructure. A proper evaluation would require in-depth follow-up on specific program results which was outside the scope of this report.

MANITOBA AGRICULTURE

The provincial Department of Agriculture plays the lead role in technology transfer by virtue of its mandate in the field of agricultural extension. In addition to the Department's own range of services, most technology transfer activities of other agricultural organizations within the province are carried out in consultation, or in cooperation, with the Department. Services are generally delivered through some 40 agricultural representatives located throughout the province, reporting to five regional agricultural offices. Specialists in livestock, crops, engineering and farm management are available at the district and regional levels to work with the agricultural representatives in providing information to Manitoba farmers. Specific activities of the Department, with respect to technology transfer, vary from year-to-year as problems and opportunities evolve but the nature of the work remains fairly constant. An indication of the type of activities carried out is provided by citing examples from published Manitoba Agriculture Annual Reports. Technology transfer activities are described under the headings of Crop Management, Livestock Management, Training and Development and General Support Services.

Crop Technology

Cereals, Oilseeds, Special Crops - New crop investigations and demonstrations form a major part of technology transfer. (Much of this work is carried out under the federal-provincial subsidiary agreement, AGRO-MAN, which is described under the section on Agriculture Canada). A wide range of projects have been initiated to test the economic feasibility and environmental adaptation of various special crops. Projects include measures to assure adequate seed supplies, demonstrations of cultural practices, testing of regional adaptability of crops, development of improved planting and harvesting techniques and evaluation of different rates of fertilizer and herbicide application.

Projects concerning crop technology generally encompass both technology assessment and technology transfer components, with test plots located in all agricultural areas of Manitoba. Technology transfer is ensured at the outset by involving concerned producers and producer organizations in the planning and development of individual projects. Once results have been obtained, the knowledge is transferred to producers by means of field tours, regional meetings and documentation of results in research reports, Departmental publications and the agricultural mass media.

Storage, drying, aeration and handling of crops to prevent loss and reduce costs is another area of technology transfer being pursued by Manitoba Agriculture. Department engineers are investigating and demonstrating such on-farm equipment as heated air dryers, aeration fans, grain handling systems and storage facilities, particularly in relation to soybeans, pulse crops and other special crops. Increased interest in the production of these crops has generated an urgent need for information on their harvesting and handling requirements.

Direct technology transfer is achieved through demonstrations of equipment at fairs and exhibitions, public meetings around the province and individual calls and visits. Departmental staff have designed many new grain handling systems for farmers and several layouts for farm scale seed cleaning plants have been developed. Indirect transfers occur through the publication of research findings. Examples would be reports on heated air grain dryers and performance characteristics of different aeration fans. Also, upgrading courses on new equipment are presented to field staff and agri-business persons who deal with producers. Consultations are also held with equipment manufacturers and dealers to discuss the needs of farmers and to provide feedback on the performance of existing equipment.

Horticulture - A program for technology transfer similar to that for cereals, oilseeds and special crops is operated by Manitoba Agriculture for horticultural producers. Extension activities are closely tied to the research and assessment of new crops and management practices. Much of the assistance provided producers deals with the special equipment used for washing, conveying and refrigerating of perishable crops. The issuing of potato contracts to new growers meant assistance in the design of storage facilities was required. Individual help has been provided by Department staff in the remodelling of existing buildings. Field days and public meetings are held on potato harvesting and storage management. Potato storages are monitored and growers are advised on how to improve ventilation systems. Carrot and onion storages have also been designed or modified by Department staff for local vegetable growers.

There is also a technology transfer program for northern horticulture. Manitoba Agriculture provides technical advice for several semi-commercial operations where the main crops are: vegetables, potatoes, forage and strawberries.

Plant Pathology Laboratory - A diagnostic service for disease problems in all crops is provided through the Plant Pathology Laboratory. Over 1500 samples are submitted annually by producers for identification of crop infections and advice on eradication. In addition, field surveys are undertaken to determine types and levels of disease infection and update information is provided for field staff in the area of plant pathology.

Forages and Pasture Management - A Department Grassland Management Program, utilizing agricultural crown lands, demonstrates the use of grass, legumes and annual crops in proper forage management. About 2000 producers are members of Grassland Societies which supply cattle for the projects and are directly involved in the management with Department staff. This is a direct technology transfer program that reaches farmers through tours, open houses, special publications, mass media and open invitations for producers to visit demonstrations at any time. Individual grassland projects are developed in each of the province's five agricultural regions by regional staff in cooperation with local producers.

On-farm demonstration projects are carried out under AGRO-MAN as a second stage of this extension program. These projects investigate and demonstrate such things as forage crop management techniques, forage seed production, sod seeding, rotational grazing, gully stabilization, native pasture treatment, round-bale silage, etc.. Field days, publications and meetings are used to transfer the knowledge acquired to the producer. The large number of projects distributed around the province, combined with extensive producer participation, ensures that a high proportion of Manitoba's livestock producers are exposed to the latest technological advances in forage and pasture management.

Soil and Land Management - Each year presentations to producers are made throughout the province by Department staff, sometimes in co-operation with agricultural researchers from the University of Manitoba and Agriculture Canada. Items usually covered include soil testing, fertilizer placement and application rates, salinity, and need for potassium and sulphur. Latest research information is also passed on to producers on such topics as zero tillage and preplant dual banding of nitrogen and phosphorus fertilizers. Demonstration plots on soil fertility and management are also established each year.

The provincial soil testing laboratory offers producers a scientific method for determining exact fertilizer requirements for crop production on an individual field basis. The soil testing services provide an evaluation of nitrogen, phosphorus, potassium and sulphur levels, soil reaction or pH, soil salinity, soil texture and carbonate or "free lime" content of the soil.

Fertilizer recommendations including types of nutrients required and rates, times and methods of application are included in the service along with information on soil management practices to deal with problems such as salinity. The fertilizer recommendations incorporate the latest technological information acquired from field and laboratory experiments on nutrient requirements and response patterns of Manitoba crop varieties. About 20,000 to 30,000 farm samples are tested annually depending on soil sampling conditions in the spring and fall.

Recently the service has been expanded to include the analysis of plant tissue testing with over 500 producers submitting samples each year.

Weed control is closely related to soil and land management. Thirty-four weed boards operate in the province. Manitoba Agriculture and municipal governments jointly fund activities of the weed supervisors who are municipal employees. Their supervisors enforce the Noxious Weed Act and contribute to the transfer of technology by extending weed control information to farmers. Each year the weed supervisors make over 4000 farm calls, inspecting fields, identifying weeds, calibrating sprayers and recommending weed control practices. To ensure weed supervisors are fully updated on weed control technology, Manitoba Agriculture provides two one-week schools and a correspondence course training program for weed supervisors.

In addition to the extension work of the municipal weed supervisors, two-day Weed Fairs at Brandon and Winnipeg provide extensive information on weed control to farmers. Information on pests, fertilizers and related equipment is also made available. The Fairs, organized with the assistance of agri-business and the University of Manitoba, usually draw a total attendance of about 5000 persons. There are also educational programs covering weed control for herbicide dealers and custom applicators. Course content includes using recommendations, plant growth stages, factors influencing herbicide performance, weed control on right-of-ways, spray

drift, herbicide incompatibility, new product registrations and weed identification. These agents are kept informed of the latest technical advances between training programs through newsletters and personal contact initiated by Manitoba Agriculture. These agents, then, act as additional channels for technology transfer to farmers with respect to weed control management.

A major contribution to the transfer of weed control technology is the Manitoba Agriculture publication, Guide to Chemical Weed Control. This detailed guide is prepared annually by the Department in cooperation with weed research personnel in the industry, universities and Agriculture Canada. It covers all the most recent herbicide recommendations for weed control in Manitoba, based on research and field experience, as well as information on application, herbicide/liquid fertilizer mixing, soil residues, winter storage and other related topics. The guide is widely distributed to local producers through the Department's Distribution Centre and 40 rural offices.

Livestock Technology

Dairy - Manitoba Agriculture field staff make close to 4000 farm visits annually to provide dairy producers with information ranging from microbiological aspects of milk production to building and equipment design. Department staff also participate in regional producer meetings aimed at increasing

the quality of milk production and herd management concerns such as mastitis control, nutrition and calf rearing problems.

On the subject of nutrition, the Department's Feed Analysis Laboratory aids livestock producers through improved nutritional programs for farm animals. Over 5000 feed samples are analyzed each year, providing comprehensive ration and feeding recommendations. Follow-up farm visits can be arranged on request. To ensure producers have ready access to the latest technical information on nutrition and nutritional practices, results from feed tests are sent out to farmers in the form of feeding recommendations.

Two milk recording services assist dairy producers with their breeding programs. Producers can join one of 20 Dairy Herd Improvement Associations (DHIA) established around the province. At present, about 250 herds are enrolled in the program which provides informational meetings with specialists, record keeping workshops and other activities to improve herd performance. The Owner-Sampler program offers producers the opportunity to place their cows on test for quantity and quality of milk production.

Beef - The nutritional services of the Feed Analysis Laboratory are available to beef producers and there are breeding programs and extension activities similar to those available in the dairy sector. A nutrition demonstration project for lightweight heifers has been in operation since 1980. Health and feeding

programs to meet the unique requirements of these calves are developed and demonstrated. The project is also used to inform producers of other practices such as preconditioning, growth implants, freeze branding and fly control. Since the cattle used in these demonstrations are owned by cooperator farmers, the level of producer interest is maintained. Producers are kept informed of project results through newsletters, articles in the farm media and field demonstrations.

Breeding programs, aimed at genetic improvements and the transfer of technical information, include the Progeny Proving Program (PPP), the Federal-Provincial Record of Performance (ROP) program and bull test stations. PPP increases the genetic quality and productivity of Manitoba's beef herd. Semen from top gaining bulls out of the Manitoba Bull Test Station is collected and offered to cooperating herds for artificial insemination. The ROP Program is a computerized record keeping system which enables producers to evaluate herd productivity through home testing. There are presently about 500 Manitoba herds utilizing this service to increase animal performance through selective breeding. An ROP Advisory Committee, consisting of federal, provincial and industry representatives, works with participating producers to improve and give direction to the program.

There are six bull test stations in Manitoba. Four are operated by Breed Associations and two are operated by Beef Performance Associations. These producer groups establish test stations to

identify genetically superior yearling beef bulls. Animals are tested for post-weaning performance under uniform conditions that allow comparison among animals from other herds. Manitoba Agriculture provides support funding for these stations and staff assist with the testing procedures.

Buildings and materials handling are major concerns to beef producers. The Department maintains, revises and distributes plans for a wide variety of farm structures through its engineering office. Existing plans are updated and new plans are developed to incorporate the latest ideas in construction technology and production practices. Other extension activities include producer seminars, short courses and workshops on a wide variety of beef management topics. Resource people for these extension activities come from Manitoba Agriculture, Agriculture Canada, the university and the industry. Attendance at the major seminars often exceeds 200 persons.

Hogs - Swine producers have increased their use of the Provincial Feed Analysis Laboratory in recent years to improve feed efficiency. Breeding stock quality and herd performance are upgraded through the Federal-Provincial ROP Program and the Commercial Hog Improvement Program (CHIP). CHIP assists producers to establish a proper record keeping system and to interpret performance information. The Program encourages a total management approach to swine production with emphasis on improving sow productivity and carcass quality. Department staff advise producers on a wide range of management problems

and supply information on new developments in the industry including artificial insemination. Producers are assisted with semen delivery and on-farm insemination supplemented by periodical training schools at rural centers.

Other major extension activities include development of a home study course, annual Hog Days event, regional producer meetings, distribution of factsheets and consultations on engineering problems. The Pork Production Course is one of a series of multi-media homestudy courses that are given through Manitoba Agriculture as the need arises[1]. Over 900 producers enrolled in the last swine course which featured the latest technical information on swine production. The course provides weekly lesson books, supplementary printed material, local meetings, follow-up seminars, special radio broadcasts and a series of related newpaper articles. Producer feedback, to provincial ministry staff suggest this type of technology transfer is highly successful.

Several hundred producers, industry and government representatives attend Hog Days organized by the Department. Producer seminars are held on various production topics and there are large displays of the latest agri-business products.

Department swine factsheets and publications cover such topics as breeding, genetics, herd health and husbandry practices. Subscriptions to the Factsheet Service are low in relation to

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1 A different topic is chosen for homestudy each year; pork production might be a topic every 8-10 years.

the number of producers but are increasing rapidly as more producers become informed of this relatively new extension service. In addition to the design of new barns and redesign of existing structures, Department engineers work with producers to develop better ventilation systems, heat exchangers and manure storage facilities.

Other Livestock - Nutrition, breeding and extension services, similar to those offered to cattle and hog producers and again aimed at farm level technology transfer are provided to poultry and sheep producers. It should be noted here that the private sector plays an important role in transferring technology to poulty producers. Beekeepers are also supported by the Department through research and extension activities. Primary extension services include newsletters, meetings, personal visits and support of producer associations.

Offering technical services to all livestock producers is the provincial veterinary system, developed and administered by Manitoba Agriculture. The Department's animal health services include provision of local veterinary care through the support of district veterinary clinics, laboratory services, information on disease prevention measures and access to top quality semen and A.I. services. Semen is obtained through the Manitoba Semen Distribution Centre which purchases semen from other provinces, the United States and overseas and makes it available to Manitoba producers for use in their breeding programs.

Training and Development

Farm Management - Farm management services contribute to the transfer of technology through individual farmer counselling on matters of financial management and the provision of technical information by means of information bulletins, computer aids, meetings and seminars. An important contribution is the farm account book, Farm Records - Basic Records for Farm Management which provides a system for modern financial management and which is updated as required. Department staff have also developed a multi-media home study course in farm mangement in direct response to farmers requests for financial management training.

A Computerized Production Planning System (CPPS) is being tested as an extension service to producers. All regions have computer terminals and or micro-computers and staff work with producers, using a number of available farm programs dealing with partial budgeting, cash flow planning, loan costs, land purchase decision-making, machinery selection, etc.. Farm management staff also participate in many of the AGRO-MAN investigational and demonstration projects by providing an economic assessment of the particular production technology under examination.

Agricultural Training - Training programs are available for farm workers and farm operators. The training of farm workers is carried out under the Canada Manpower Training Program (CMTP) and the Canada Manpower Industrial Training Program (CMITP) of

Employment and Immigration Canada. Agricultural training courses for farmers are organized by Manitoba Agriculture and the Department of Education in consultation with the University of Manitoba and the Assiniboine Community College. These programs and courses are described in the section of this report dealing with the College, under educational institutions. Manitoba Agriculture's involvement consists of working with the Department of Education to determine the location and content of training courses, supplying regional staff to assist in the monitoring of on-the-job CMITP training and providing resource persons for course instruction.

Many courses are held at the Department's Agricultural Extension Centre in Brandon which provides facilities for adult education and agricultural extension activities. Courses sponsored by the Centre deal primarily with agricultural production technology with over 30 courses presented each year. Some of the course material is taped for broadcast on farm radio and television programs while printed material is made available to the press.

Finally, technology transfer is enhanced, in a limited manner, through the training of rural youth via the 4-H Program. Farm youth can learn the basic skills of animal husbandry and crop production by becoming involved in 4-H projects. Manitoba Agriculture provides central and regional staff support for the Program which is primarily a volunteer-run organization. The Department also supplies project manuals and participates in leadership development workshops.

General Support Services - General services provided by Manitoba Agriculture that contribute to technology transfer include communications, water services and support for the Prairie Agricultural Machinery Institute (PAMI). The Communications Branch supplies all the printed and audio-visual aids used in the extension activities described above. Most of the technical content is provided by Department specialists. The Department also operates province-wide radio and television services which pass on some technical information but, more importantly, promote other extension activities such as soil testing, home study courses, farm seminars, weed fairs, etc. In addition, about 650 pages of Manitoba Agriculture information is available on the "Grassroots" Telidon system operated by Infomart and the Manitoba Telephone System, with some 20 demonstration terminals placed in Regional Offices (see Agri-business section).

Through the Agri-Water Branch, the Department makes available technical assistance for on-farm water source development through farm visits and detailed design of water systems. Financial assistance is provided for some cases which do not qualify for assistance under the Prairie Farm Rehabilitation Administration (PFRA).

The three Prairie Provinces jointly fund the Prairie Agricultural Machinery Institute (PAMI) and Department of Agriculture staff assist in directing the Institute's activities. PAMI evaluates farm machinery and does

development work to improve machinery design for operation under prairie conditions. Facilities are located at Humboldt, Saskatchewan; Lethbridge, Alberta and Portage la Prairie, Manitoba. Evaluations and research findings are published by the Institute and made available to farmers and agri-business.

EDUCATIONAL INSTITUTIONS

University of Manitoba - Faculty of Agriculture

Information on the activities of the Faculty of Agriculture was obtained from the 29th Annual Progress Report January 1983 - Agricultural Research Teaching and Extension, Faculty of Agriculture, University of Manitoba. The faculty plays a major role in the development, assessment and adoption stages of technology transfer in agriculture. Technology development and assessment are carried out under the faculty's research program which encompasses all aspects of agriculture including economics, engineering, animal science, entomology, food science, plant science and soil science. Research funds from various granting agencies amounted to $4.1 million in fiscal 1981-82. With respect to technology adoption, the faculty is involved through both teaching and extension activities in which staff participate.

Teaching - The teaching program of the Faculty of Agriculture consists of a two-year diploma course, a four-year degree course and post-graduate studies at the Masters and Doctorate levels. In addition, a diploma program in dairying, of up to one year in duration, is offered when demand warrants and a degree program in agricultural engineering is available through the Faculty of Engineering.

The diploma program is most closely related to on-farm technology transfer as it is designed to train farm managers in the scientific and economic aspects of farming. Annual enrollment is currently at about 240 students which is near capacity for the program. About 80 to 90 students graduate each year with approximately three-quarters going into farming and most of the remaining graduates entering into agriculture-related occupations. Required courses such as communications, farm power, machinery, marketing, livestock, insects, farm business management, crop science and soils provide the student with the latest knowledge on subjects essential to the successful operation of a farm. Optional courses in the second year of the program allow students to acquire specialized training in one particular sector of the industry.

The diploma program is kept current and up-to-date by maintaining close ties with commercial farm operations and agri-businesses. Students study the management practices of about fifteen farms with a variety of enterprises during field trips and visit agri-businesses to study the processing and marketing of farm products. In addition, courses are constantly up-dated to keep abreast of technological change and evolving farm management practices. Recent innovations include the use of computers in the second-year farm business planning courses, a Telidon unit which provides market reports, chemical and fertilizer recommendations, weather forecasts, etc. and the expansion of study in the area of law as it applies to business arrangements and family estate planning.

The degree and graduate studies programs operate on a larger scale than the diploma program but a smaller proportion of graduates become actively engaged in farming. At present, about 60 percent of the students in the agriculture degree program come from urban areas. Many of the graduates, however, do become directly involved with the industry through employment in government or agri-business. Enrollment was up in 1982 after two or three years of decline with a total of 874 full-time and part-time students working towards undergraduate and post-graduate degrees. Some 153 degrees were conferred in 1982, 51 of which were at the post-graduate level.

Extension - Extension activities are becoming an increasingly important function of the faculty staff. Agricultural research at the University generates new information each year and it is through various extension activities that this new information is transferred to farmers and farm related businesses. An estimated 8,700 contact hours (seven man-years) of extension education for some 64,000 persons was provided by faculty staff in 1982. A high proportion of this service is directed at farm operators and professionals serving the agricultural industry. One major benefit to the faculty from extension activities is the feedback from participants which enables the staff to monitor the needs and problems facing the industry and to develop more relevant research and teaching programs.

Extension services take many forms. There are group activities that range from formal credit courses, such as dairy technology and beekeeping, to informal tours and field trips to research stations. In 1982, there were 58 group activities on such topics as futures trading, soils management, and horticultural production for a total of over 950 contact hours with 2,900 individuals. Faculty staff also participated in 190 group extension activities organized by producer groups, Manitoba Agriculture and other agencies, reaching about 14,000 persons. An additional 4,000 young people were contacted through career days, educational tours or workshops attended by schools, 4-H Clubs, etc..

Extension services are also provided on a one-to-one basis by means of telephone, correspondence or office visits. Over 22,000 such contacts were expected in 1982 with about 13 percent from producers, 34 percent from industry and government and the remainder from other researchers and the general public. Faculty staff also act as resource persons on some 220 public service committees concerned with agricultural policy and program matters.

Both fundamental knowledge and new technological developments in agriculture are passed on to producers, agri-business and the general public through the media. Faculty staff provided 23 in-depth radio and television interviews, 65 short radio tapes and about 300 articles for the general news media and professional journals in 1982.

The faculty cooperates closely with Manitoba Agriculture on research and extension activities to ensure the best possible use of human resources. Each September faculty executive meet with Department Regional Directors and the Executive Committee to coordinate joint extension activities, such as lectures to producer groups throughout rural Manitoba for the winter season. During May and June, meetings are held to identify and establish priorities for research needs in each of the agricultural disciplines.

Assiniboine Community College

The Assiniboine Community College located in Brandon, is involved in agricultural training through the federal Canada Manpower Training Program (CMTP) and through Manitoba Agriculture directly. CMTP is used for training programs developed and delivered for hired farm labour. Responsibility for recruitment of participants lies with Manitoba Agriculture and Employment and Immigration Canada. CMTP courses are held around the province in rural centres such as Brandon, Morden and Steinbach and range in length from about 4 to 16 weeks. The College puts on 8-10 CMTP courses each year, averaging 10-15 trainees per course. The various courses train farm workers in general agricultural production practices, technical skills, dairy herd management and maintenance, and farm equipment operation. Although most CMTP training is through the Assiniboine Community College, some trainees are placed in the University of Manitoba Agricultural Diploma course or the Dairy Diploma course.

Agricultural training courses for farmers are generally much shorter in duration (one or two days in length) and are held outside the CMTP. These courses, delivered through Assiniboine Community College, are requested by Manitoba Agriculture with funding provided by the Department of Education. General courses, such as hydraulics, tractor maintenance and farm accounting, account for most of the training although special courses such as grain drying and labour relations are also offered as required. About 70-80 non-CMTP courses are delivered each year with total attendance around 800-1000 participants.

College trainees, who have completed courses, may follow-up their training with on-the-job training under the Canada Manpower Industrial Training Program (CMITP). This Employment and Immigration Canada program places inexperienced workers on farms where they receive training from the farm operator. During the training, CMITP subsidizes the wages of the trainee. About one hundred such training contracts are authorized each year.

FEDERAL ORGANIZATIONS

A booklet prepared by the Ministry of State for Science and Technology entitled The Government of Canada's Support for Technology Development, outlines direct federal involvement in the development and transfer of technology to Canadian industry. In 1983/84, federal expenditures on programs and incentives in support of technology enhancement are expected to exceed $850 million[2]. This support is in the form of tax incentives, financial assistance for research and development, provision of scientific and technical information and training assistance. Benefits from many of the activities will trickle down to farmers although direct contact with farmers is not common. Federal activities pertaining to agricultural technology transfer are carried out mainly by Agriculture Canada through its functions of research, promotional and regulatory services, and assistance programs and, to a limited extent, by Employment and Immigration through its manpower training programs. Other federal departments, such as Statistics Canada, Environment Canada and Consumer and Corporate Affairs, have significant impact on Canadian agriculture but little or no direct input to technology transfer. Programs and activities of major importance to producers in the province of Manitoba are described on the following pages.

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2 Support for Technology Development - A summary of Federal Programs and Incentives, 1983/84. Cat. number ST31-13/1984

Agriculture Canada

Agriculture Canada plays a vital role in agricultural technology transfer through the activities of its various branches in cooperation with Manitoba Agriculture and other agricultural organizations. The main branches involved are Research, Food Production and Inspection, Regional Development and Communications.

The Research Branch has a mandate to provide new knowledge and improved technology to increase the level, variety and efficiency of agricultural production. Activities in Manitoba are carried out at the Winnipeg, Brandon and Morden research stations. Research projects are distributed among these stations to avoid duplication of work.

At Winnipeg, research emphasis is on the development of improved cultivars of wheat, oats and barley suitable for production in the Prairie Provinces, the development of integrated methods of protecting crops against disease and insects, and the improvement of storage practices for cereals, oilseeds and their products. Other activities of the station include a cereal quality screening service for Canadian wheat and barley breeding programs.

The station at Brandon undertakes research projects in both crops and livestock. Research programs include beef cattle breeding, swine production management, nutrition, physiology

and genetics, breeding, physiology and management of barley, corn, soybeans and sorghum, weed control in cereal, oilseed, and forage crops, general agronomy and plant nutrition.

The Morden station serves as the centre for new crops and horticultural research for the Prairies. Specific research projects are aimed towards the development of new cultivars and improvement of management practices for buckwheat, field corn, field peas, pulses, flax, sunflowers, potatoes and herbaceous and woody ornamentals.

Each station has an information officer who is responsible for the dissemination of research results and recommendations to farmers. Dissemination activities include monthly information releases, demonstration-plot tours and seminars, television shows, radio broadcasts and contributions to "Grassroots" - the electronic agriculture information system. In addition, the Brandon station sponsors producers' days for livestock farmers. The monthly information release reaches farmers through a network of some fifty community newspapers, farm magazines, special interest groups and CBC radio.

The Branch's on-going research in the area of energy, although not emphasized at the Manitoba stations, contributes to more efficient agricultural production. The Energy Research and Development in Agriculture and Food (ERDAF) program, implemented in 1980, supports research and development of new technologies in energy conservation and other areas such as the

production of energy from waste products, the use of solar energy and the substitution of natural gas, propane and electricity for oil based fuels. Agriculture Canada administers ERDAF, with funding from the federal government's National Energy Program, but the research work is contracted out to the private sector. The projected funding for the primary production segment of agriculture is $1.45 million in 1983-84 and $1.65 million in 1984-85.

The Food Production and Inspection Branch enhances technology transfer in a more indirect manner through its administration, inspection and regulatory functions. In cooperation with the Regional Development Branch, Food, Production and Inspection administers, delivers, and supports a genetic improvement, on-farm program (ROP) to improve production efficiency and product quality for dairy, beef, swine and sheep. These Branches also cooperate in programs that support activities of agricultural shows and producers organizations, pertinent to production improvement for livestock, poultry and plant products. Unlike the Research Branch, technological knowledge is transferred in an informal (one-to-one) manner by branch personnel.

Regional Development Branch's major impact on technology transfer has been through the implementation, in co-operation with Manitoba Agriculture, of the Canada/Manitoba Subsidiary Agreement on the Value Added Crop Production program known as Agro-Man and described in the following section.

Communications Branch contributes to technology transfer through the publication and distribution of research and special topic bulletins and articles. On average, Communications distribute nationwide some three million copies of publications to provincial departments, universities and the general public annually.

A major publication of the Communications Branch in terms of technological knowledge is Canadex. Canadex is made up of one-page technical leaflets written mainly by researchers at Agriculture Canada Research Stations. Approximately one hundred technical leaflets are published annually covering a wide range of topics under the following categories - field crops, horticultural crops, livestock, soil management and fertilizers, insects and diseases, and agricultural engineering and economics. Canadex information is disseminated through extension workers, instructors in agriculture, provincial information officers, farm magazines and TV and radio programs.

Agro-Man - In Manitoba, federal-provincial cooperation in economic development has been carried out through a General Development Agreement (GDA). Under the GDA, there was a Canada/Manitoba Subsidiary Agreement on Value-Added Crops Production referred to as Agro-Man. Agro-Man was a set of projects aimed at accelerating the expansion of value-added crops production, especially those which are processed or could be processed in Manitoba, and improving the efficiency of

production and conversion of crops, through livestock, into red meat. The federal government, through Agriculture Canada, contributed $11.1 million to this $18.5 million agreement which expired March 31, 1984. Projects approved by this date will be cost-shared by Canada and the province up to September 30, 1985.

At present, negotiations are underway to establish a subsequent agriculture sub-agreement. A Memorandum of Understanding was signed on January 12, 1984 between the Federal and Provincial governments pledging $38.3 million (Federal $23 M, Manitoba $15.3 M) towards the future development of Manitoba's agri-food sector, under the new Economic and Regional Development Agreement (ERDA) which replaces the GDA. The Regional Development Branch of Agriculture Canada has the lead role for the federal government in both the implementation of the current Agro-Man agreement and the development of its successor.

Agro-Man projects have been developed jointly by staff from Agriculture Canada, the University of Manitoba and the provincial departments of Agriculture and Natural Resources, often in consultation with individual producers or producer associations. For example, a soybean project, managed directly by Manitoba Agriculture, enlisted cooperating farmers to grow soybeans on field-sized plots of 9 to 23 hectares. The results are passed on to other interested farmers through the department. The Manitoba Corn Growers Association establishes corn growing demonstrations on nine hectare plots at 20 to 30

locations per year, under a contract with Manitoba Agriculture. Cooperating farmers grow corn for two years using technical advice and assistance provided by an agronomist employed by the Association as well as by Manitoba Agriculture staff. Both the Department and the Association are involved in the extension of knowledge acquired from the demonstration plots to interested farmers.

On-farm demonstrations, regional trials and extension programs provide new information to farmers on technical and managerial practices. There are four distinct programs within Agro-Man as shown in the following table taken from Volume I of the February 8, 1982 Mid-Term Review 1979-1982 report of the Agro-Man Agreement.

Program Objectives - Agro-Man Agreement

Program Number	Program Name	Objective
1.	Value-Added Crops Investigation and Evaluation	To provide for investigations of the technical implications and the potential and/or realized impacts involved with the introduction and expansion of value-added crops.
2.	Special Crops Products	To assist in the expansion and sustained production of special crops, primarily those crops which are processed or have a potential for processing in Manitoba.
3.	Livestock Products	To improve the production, handling and utilization of crops grown for livestock feed.
4.	Related Productivity Measures	To implement productivity measures that will remove constraints to the production of value-added crops with particular attention to the development of land and water management projects, primarily in three crop production zones: Southeast, Assiniboine South, and Portage-Carberry.

Under the value-added program, technology transfer is enhanced through investigations into crop production potential and crop product utilization technology. Some of the crops under investigation include wild rice, dry green peas, lupins, canola and triticale. Results are passed on to farmers by means of news releases, brochures, Agreement activity summaries and publications describing demonstrations, results and recommended practices.

Activities in the special crop program are aimed at demonstration of new or updated crop production technology on a variety of farm situations in all the major crop growing regions of the province. Performance data on a large number of special crops, forage, cereal and horticultural crops are demonstrated in field plots and presented in seminars to local producers. The results are also used to update provincial field crop recommendations published each year by Manitoba Agriculture. To date, projects have been carried out on silage and grain corn, potatoes, soybeans, sunflowers and selected pulse crops. The demonstrations have proven particularly valuable to farmers growing one of the crops for the first time. Adoption of technology by first-time growers is enhanced by the presence of local farmers who have grown the crop under the direction of specialists.

The livestock products program endeavours to enhance the transfer of technology relating to the utilization of crops for livestock feeding. Farmers have the opportunity to experience,

through the Manitoba Agriculture regional field operations system, grassland and forage demonstrations and livestock products efficiency demonstrations. These demonstrations are designed to reflect unique local conditions affecting production. Developmental type projects such as the clearing and planting of previously tree-covered rangeland using specialized equipment
demonstrate the technology available for large scale forage production that can be adopted by farmers. Also, projects studying the effects of trace minerals on feed utilization by livestock and the use of canola meal in livestock feeds are in the initial stages of implementation.

The related productivity measures program emphasizes drainage and irrigation works to alleviate constraints to production of value-added crops and to demonstrate the economic capabilities of arable organic soils. Both Manitoba Agriculture and Manitoba Department of Natural Resources are involved in implementing the various projects with the latter ministry solely responsible for major water management activities. Technological improvements on field crop irrigation systems are demonstrated by ongoing field trials. These trials help farmers to determine, among other things, the most economically feasible water application rate for maximum crop yield.

Prairie Farm Rehabilitation Administration (PFRA) - The PFRA was established in 1935 by an Act of Parliament with the major goal of combating drought and soil drifting which were creating havoc with prairie agricultural production. Except for the period April 1969 to March 1983, PFRA functioned from its inception under the auspices of Agriculture Canada (during the 1969 to 1983 period, PFRA was under the Canada Department of Regional Economic Expansion). As part of its mandate, PFRA provides technical and financial assistance to farmers (individually and in groups) and rural communities for improving water management, irrigation and general production practices.

During fiscal 1982-83, Manitoba farmers and communities developed and improved over 1,000 dugouts, stockwatering dams, irrigation projects, wells and pipelines with PFRA's technical and financial assistance. By providing technical assistance to locate, survey, design and inspect on-farm water storage and irrigation projects, PFRA helps farmers to adopt improved technological production practices which enhance crop and livestock production and minimize the detrimental effects of adverse weather conditions.

The PFRA Demonstration Farm located in the south of the Saskatchewan River Irrigation Project area acts as a catalyst in the dissemination and adoption of agricultural irrigation technology through on-farm demonstrations. Crops such as grain corn, canary seed, soft wheat, oats, peas, barley, alfalfa,

triticale, grass legumes and seed potatoes are demonstrated under different irrigation systems and production techniques. Also, livestock feeding trials utilizing farm grown feeds in feedlot conditions are demonstrated.

Management of soil and water conservation benefit from the distribution of seedlings from the PFRA Tree Nursery at Indian Head, Saskatchewan. Seedlings are distributed free of charge to prairie farmers for the establishment of farmstead, field and roadside shelterbelts. In 1982/83, over 1.6 million tree and shrub seedlings were distributed in Manitoba. The seedling service has been instrumental in enabling farmers to minimize soil drifting, to retain snow on fields and to protect on-farm water storage. PFRA also provides technical advice and on-site assistance in establishing and maintaining these shelterbelts.

In Manitoba, PFRA operates 24 Community Pastures, which utilize marginal and sub-marginal lands unsuitable for cereal production, covering some 162,000 hectares. The program demonstrates improved range management practices for both pasture and cattle production. Purebred breeding bulls are maintained to provide a high-quality genetic pool to service patrons' cattle and demonstrate the benefits of selection in breeding. Farmers also gain on-farm experience in better animal husbandry and pasture production techniques through the range of services offered.

Farm Credit Corporation (FCC)

The FCC, a federal corporation responsible to the Minister of Agriculture, plays a major role in granting long-term mortgage credit and providing advisory services to farmers in order to establish, develop and maintain financially viable farm enterprises. The operation of the organization is decentralized to better focus on unique local conditions. Farmers in Manitoba are serviced through a regional office.

Through pre-loan counselling and on-farm visits to borrowers, trained FCC staff enhance the adoption of improved "soft" technology by acquainting farmers with farm financial planning techniques. Techniques such as budgeting and financial analysis are illustrative of the topics that credit advisers may cover with borrowers. In Manitoba, in fiscal 1982/83, FCC staff made 445 farm visits with an average of 1.3 visits per borrower. Apart from in-office and on-farm counselling, FCC personnel also serve as resource people at meetings and workshops. These meetings organized for farmers by other organizations such as Manitoba Agriculture are normally open to the public and expose both borrowers as well as non-borrowers to improved financial planning techniques.

PRODUCER ORGANIZATIONS

Beef Breed Associations

In Manitoba, many beef breed and beef performance associations are concerned with beef production with the major objective to improve and expand production of their respective breed of cattle. Working in close cooperation with Manitoba Agriculture, the associations maintain bull testing stations where farmers can take their bulls for testing of performance traits such as average daily gain.

The Manitoba Limousin Bull Test Station and the Manitoba Maine-Anjou Bull Test Station are examples of stations that are exclusively for one breed. The Manitoba Bull Test Station (MBTS) on the other hand is open to all breeds. At the MBTS, bulls must obtain a 95% rating in order to be eligible for sale as breeding bulls. These bull-testing programs are an important part of the process of getting farmers to adopt improved genetic technology. Apart from a good source of breeding bulls, the stations demonstrate the effect of proper nutrition, husbandry and handling facilities. The associations also disseminate technological improvements through newsletters, seminars, farm tours and one-to-one counselling.

Commodity Groups

The commodity groups play a major role in the overall promotion of their respective commodities, but to this point they have had a limited role in affecting production technology at the farm level. Two groups with direct farmer contact in Manitoba are the Manitoba Cattle Producers Association and the Canadian Seed Growers Association. The Western Fertilizer and Chemical Dealers Association and the Manitoba Hog Producers Marketing Board have more indirect contact with farmers.

The Manitoba Cattle Producers Association, an elected organization representing all cattle producers in the province, promotes efficient cattle production and marketing. Through monthly bulletins and semi-annual publications, farmers learn about the latest in production techniques from research results and the experiences of other farmers. A new program, introduced by the association to improve the performance and minimize sickness and death loss normally experienced by cattle entering feedlots, is the Manitoba Certified Preconditioned Feeder Program (MCPF). Under the program, farmers work closely with veterinarians in a comprehensive health management scheme. All animals sold under this program are certified by a veterinarian.

The Manitoba Branch of the Canadian Seed Growers Association plays an active role in the development of modern seed production techniques in conjunction with the University of Manitoba. Results and production practices of sponsored trials

at the University are disseminated through newsletters, seminars and field days. Annual probation grower short-courses and seed grower short-courses are also invaluable tools used by the association in fostering better seed production practices.

A group with no direct farmer contact but which plays an important role in technology adoption is the Western Fertilizer and Chemical Dealer Association. This group is a voluntary organization with about 145 members dedicated to the advancement, promotion and protection of the fertilizer and chemical industry. Through annual conventions, tradeshows, seminars and a quarterly publication "The Communicator" dealers of agricultural chemicals and fertilizers learn about the latest developments in the industry. The dealers in turn, influence farmers use and acceptance of a product by recommending improved practices on such topics as application rate, when and how to apply and what to apply for specific situations.

Although marketing is the main concern of the Manitoba Hog Marketing Board, the Board's participation in the quarterly publication, "Western Hog Journal", contributes to farmers' knowledge of improved production practices. The Journal features articles on farmers' technical experiences, research results and production practices at various stages of hog production.

AGRI-BUSINESS

Pool Elevators and Grain Companies

In Manitoba, the major pool elevators and grain companies enhance agricultural production by the transfer of technical information to local farmers. Companies such as Pioneer Grain Co. Ltd., Manitoba Pool Elevators, and United Grain Growers have direct contact with farmers through their elevator managers and field representatives.

At Pioneer Grain, the elevator managers are usually agrologists and advise farmers on production practices including land preparation, choice and application of fertilizer and chemicals, marketing and storage of crops. Pioneer Grain also has a "special crop agrologist" on staff who works mainly with farmers who produce crops, under contract, for the company. Most extension work is done on a one-to-one basis and, unlike other companies, it has no publications such as newsletters or magazines.

Manitoba Pool Elevators offers one-to-one and group advisory services. The company publishes a monthly newsletter and a weekly farm magazine "The Manitoba Co-operator" with a circulation of 45,500, and holds local meetings where staff and other resource personnel present and discuss special topics on the industry. The company also contributes to seed plot trials which serve to demonstrate better production techniques to local farmers.

United Grain Growers is owned by 94,000 Prairie farmers. The company also offers both one-to-one and group advisory services to farmers. Their professional field staff and elevator managers play a substantive role in informing farmers on up-to-date production techniques. Field tours, seminars and the farm press are an integral part of United's information dissemination package to farmers. Apart from news releases, the company's farm newspaper the "Grainews" with a 60,000 monthly circulation in the Prairies, serves as a unique forum where farmers exchange ideas and technical experience. Its subsidiary, Public Press, publishes "Country Guide" and "The Cattleman", and other magazines on specific farm enterprises. Special sections published are the Crop Guide (annually), the Corn-Soy Guide (twice per year), Hog Guide (six times a year), and Dairy Guide (six times a year).

Agricultural Machinery Companies

Agricultural machinery companies in Manitoba operate under licence issued by the Manitoba Farm Machinery Board which administers the Manitoba Farm Machinery and Equipment Act. In 1982, 498 licensed dealers and 149 licensed vendors provided agricultural machinery sales and service to Manitoba farmers selling basically the same or competing machinery while offering farmers a wide selection to meet individual needs on the farm.

By offering the latest models for sale, the companies provide farmers with the opportunity to adopt technologically improved machinery and equipment to enhance farm production. However, as previously noted, the basic evaluation, research and development role is played by the Prairie Agricultural Machinery Institute - a joint venture of the provinces of Manitoba, Alberta and Saskatchewan.

Chemical Companies

The Canadian Agricultural Chemicals Association (CACA) is the major group that encourages cooperation among provincial officials, federal officials and the pesticide industry. Two objectives of CACA's Manitoba Provincial Council are to promote the safe use of pesticides on the farm through encouraging growers to follow practices that ensure pesticides are effectively used and in accordance with the manufacturer's label directions, and to disseminate technical and trade information regarding pesticides. The association pursues its objectives by working in cooperation with individual member companies.

Chemical companies' contact with farmers varies greatly and is mainly through their dealers, farm seminars, farm tours and printed material. Dealers are kept up-to-date by professional sales representatives and special training programs sponsored by the individual chemical company. Farm seminars and farm

tours are often sponsored in conjunction with Manitoba Agriculture. Where possible, demonstration plots are placed on cooperating farms which enhances adoption by farmers of new products and techniques because of the greater degree of credibility.

Infomart - "Grassroots"

In Manitoba, commercial electronic dissemination of agricultural information became available with the introduction of "Grassroots". "Grassroots" was introduced by Infomart in cooperation with the Manitoba Telephone System in the fall of 1981 with financial assistance from the federal Department of Communications. The system offers a computer bank with over 20,000 pages of information which is accessible through clients' private telephone lines.

To date, information is offered under three major categories - agricultural, lifestyle, and finance. Topics in the agricultural category include crops and livestock, weather, farm management, computer programs, oilseeds and special crops, newsletters, news, herbicides and pesticides, equipment, real estate, government, research, and classified advertisements. Under the lifestyle category, topics include consumer information, entertainment, travel, sports, education, consumer agencies, games, health and home, and news and weather. The

Finance category provides information from the Toronto stock exchange, commercial banks, and other financial institutions.

The most popular agricultural topics with producers are weather, futures and street prices, market analysis and farm management. Through the farm management programs, producers receive information that may help them to make more profitable management decisions. Among the packaged topics are feedlot profitability, wheat production, sprayer calibration, sprayer cost, hog finishing profitability, machinery selection, herbicide usage, on-farm grain storage, and fertilizer utilization.

SUMMARY

The present report provides an overview of the formal technology transfer process in Manitoba agriculture. Agricultural technology transfer in Manitoba is characterized by a highly complex network involving both levels of government, educational institutions, agri-business and producers. Manitoba Agriculture, by virtue of its mandate in agricultural extention, plays the lead role in technology transfer in the province. Drawing from its own basic research, Agriculture Canada cooperates with, or consults with, other agricultural organizations in formulating research projects and in disseminating technical information to farmers. The existing transfer process relies heavily on extension services with a "trickle-down" diffusion system whereby a few early adoptors of technological improvements are used as role models for the general farm community. The major media of exchange used in the dissemination of information are bulletins, seminars, farm tours, demonstration plots, telecommunications, farm publications, one-to-one contact, and the news media, including daily, weekly and community newspapers, radio and television.

Documentation of the formal technology transfer process is seen as a first step in the eventual designing of more effective technology transfer programs in terms of achieving the industry goals of increased efficiency, resource conservation and economic growth. Other major elements were identified in the introduction of this report and include:

- identifying emerging technologies
- measuring technological gaps
- determining the causes of specific technological gaps
- identifying alternative technology transfer mechanisms
- establishing criteria for selection of technology transfer mechanisms
- establishing monitoring and evaluation procedures for technology transfer programs

In the preparation of this report, it was found that information regarding these elements was limited and not well documented. Individuals charged with the responsibility of developing technology transfer programs, involving substantial resource commitments, receive strong support at the research/development and program implementation/management stages but face difficulties in identifying what technologies to transfer and how best to transfer them. The problem may be attributable to the fact that technology transfer has evolved as an offshoot of the traditional disciplines of livestock, crops, soils, business management, etc. No one group is specifically concerned with the process of technology transfer. It would appear that substantial benefits could be derived from a well-coordinated effort to address the above elements which are fundamental to any formal technology transfer process.